Continuous Descent Approach Design for Independent Dual Runway Operation at IAH

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Design Approach

- 3 D path operation:
  - FMS constructs 3 D CDA path based on defined waypoints and constraints
  - Auto-pilot and Auto-throttle controls the descent using LNAV and VNAV function to follow the FMS defined 3 D CDA path
- Published pre-defined 3 D path available to both air and ground supports near-term implementation using voice for clearance delivery, and serves as transition to integrated datalink operation
- Ground automation tools select path option to sequence and separate A/C under medium to heavy traffic
  - Pre-defined path options with different path lengths support near-term implementation of A/C spacing

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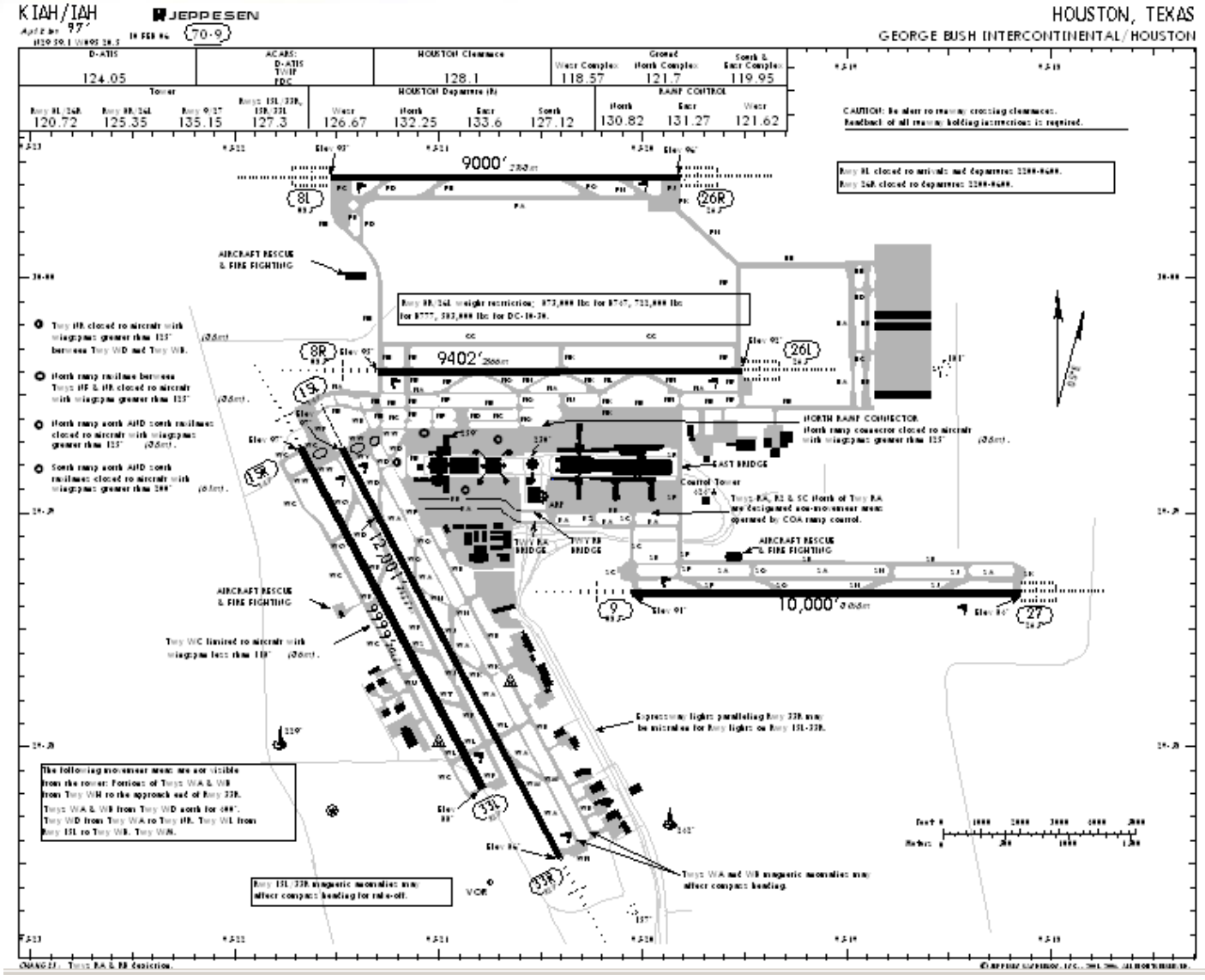
Bush Intercontinental Airport at Houston, TX



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Constraint for Parallel Runway Operation

- Simultaneous Independent ILS approaches to dual & triple parallel runways:
  - FAA 7110.65P specifies a minimum of 1,000 ft vertical or a minimum of 3 miles radar separation between aircraft during turn-on to parallel final approach
- To satisfy required separation during turn-on, ground track and vertical profiles should be insensitive to aircraft type, flap configuration, speed profile and wind before established along the localizer or ILS
  - Vertical profile supports reasonable deceleration while descending

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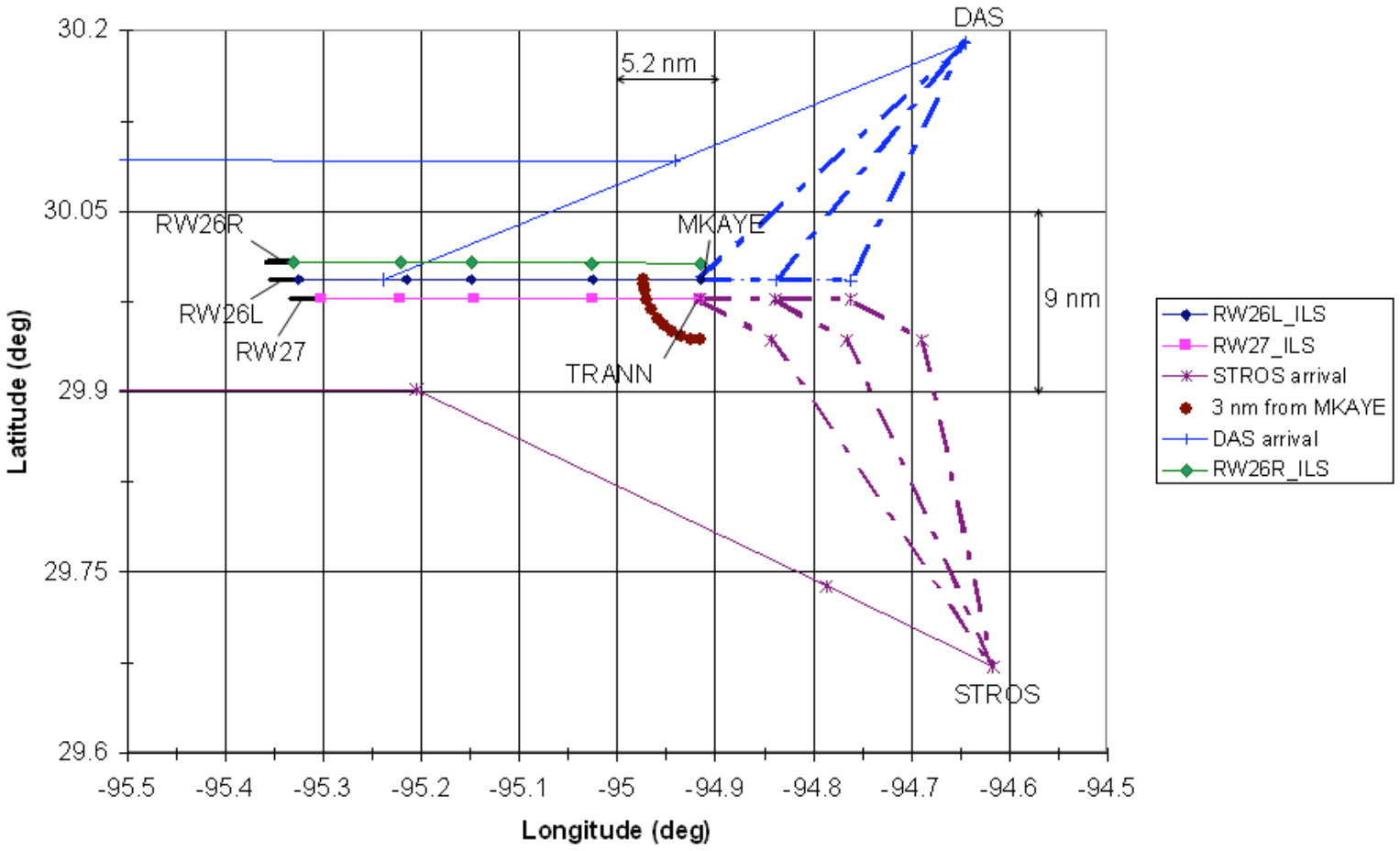
Final Approaches for RW26L/R and RW27



Require 1,000 ft vertical separation between CDAs to RW26L/27 during transition to final approach

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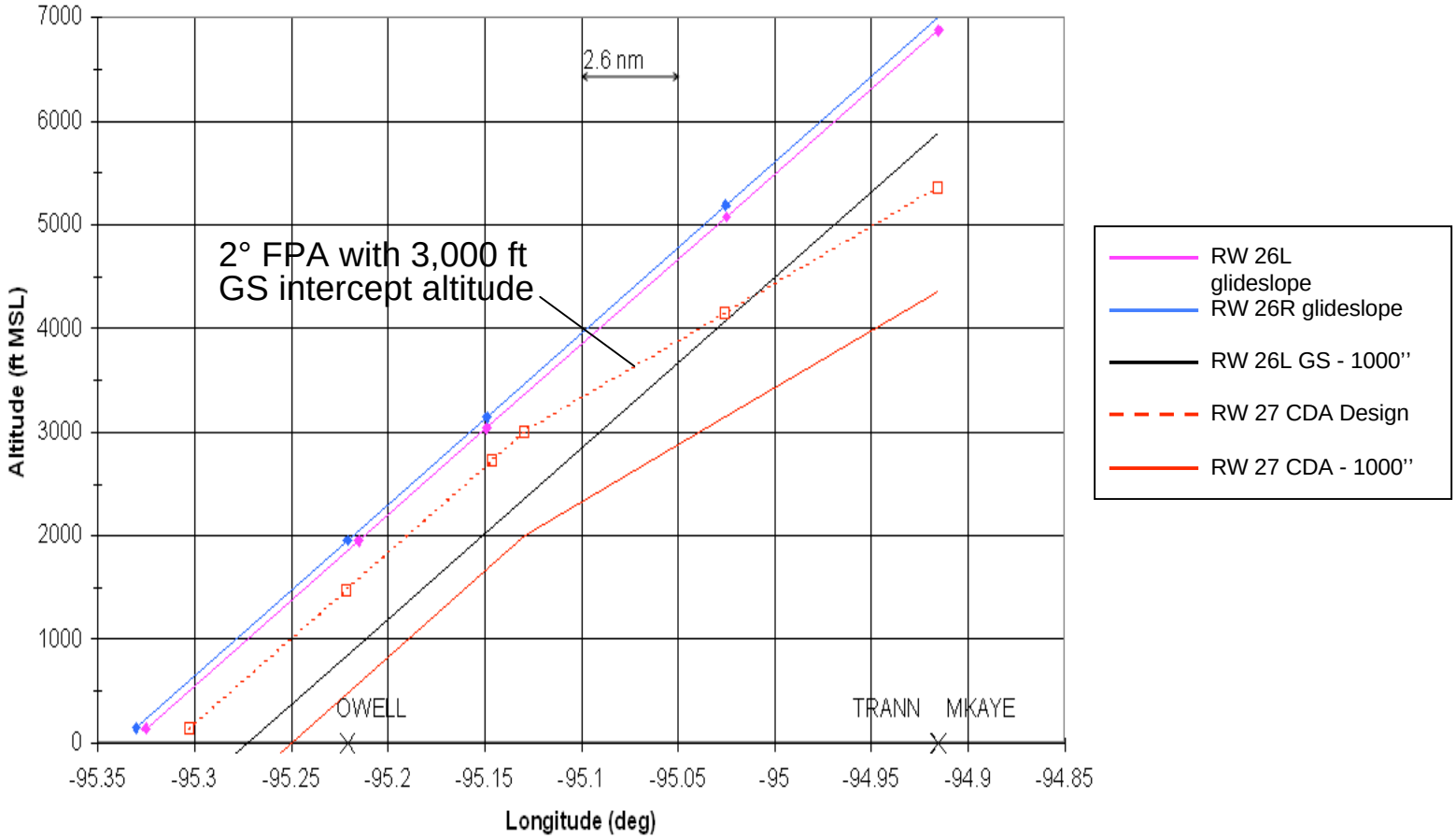
Vertical Constraints on CDA to RW26L/27



- CDAs to RW26L/27 with 1,000 ft vertical separation is feasible
- 2,000 ft altitude along Final Approach for step-down to RW26R

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Design Features for CDA Vertical Profile

- Two descent segments:
  - Idle engine thrust descent from cruise to 11,000/10,000 ft near Tracon entry points
  - Low engine thrust descent along 2º path from Tracon entry to glideslope intercept for precise vertical trajectory required by vertical separation
- Level segment between two descent segments to provide:
  - Possible reselect path options in Tracon
  - Compensate differences in idle descent trajectory caused by inaccurate wind data in FMS and Flight Technical Error
- Path options with different path lengths in both Center and Tracon airspaces for medium to heavy traffic

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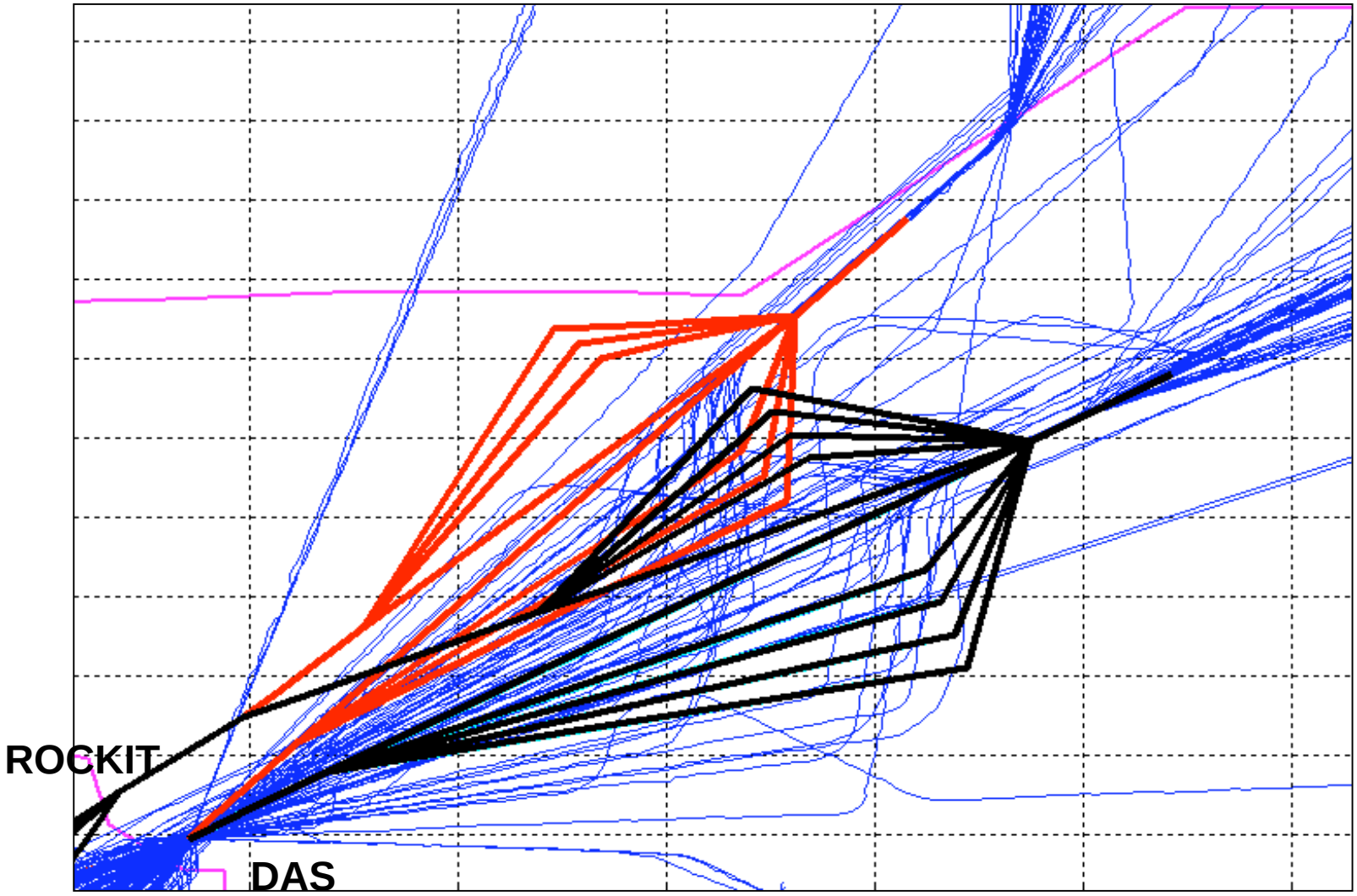
3D Path Options Overlay Current Paths by Vectoring



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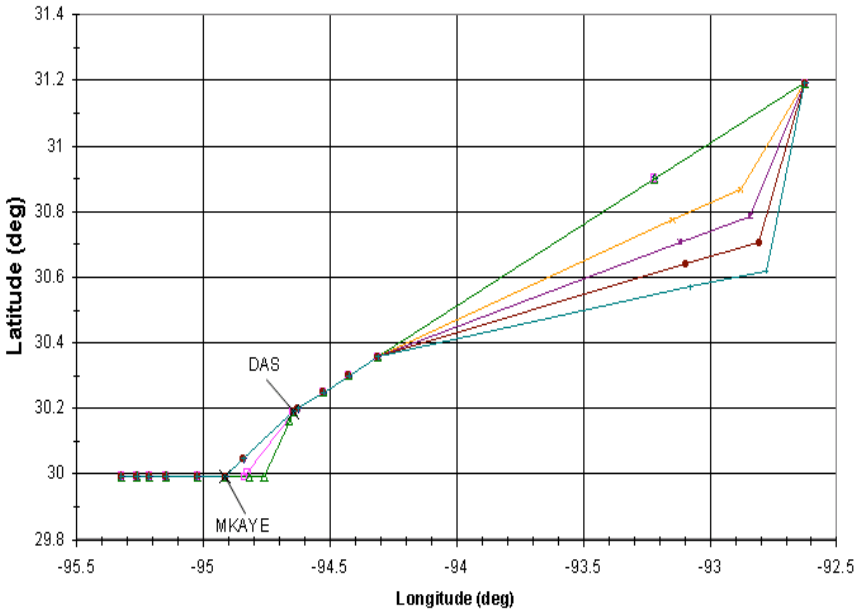
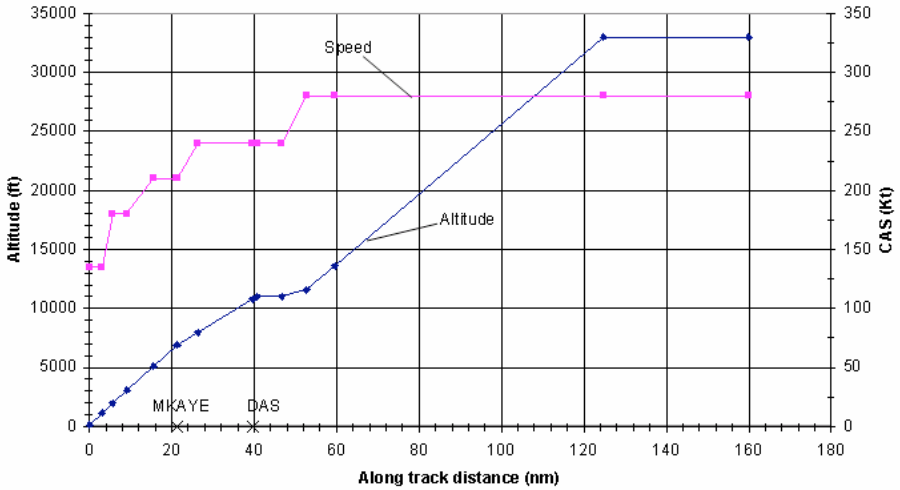
Profiles for CDA Descent to RW26L

Path options



Vertical and speed profiles along nominal path



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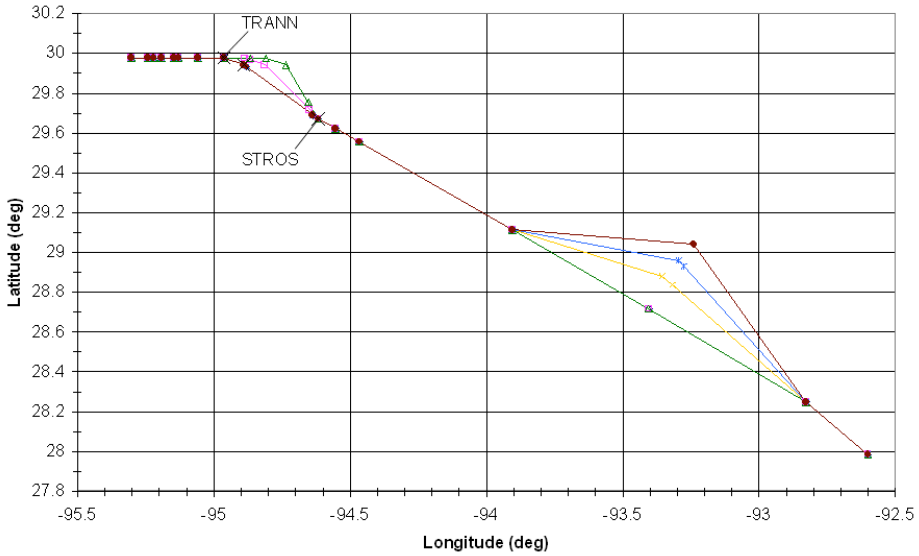
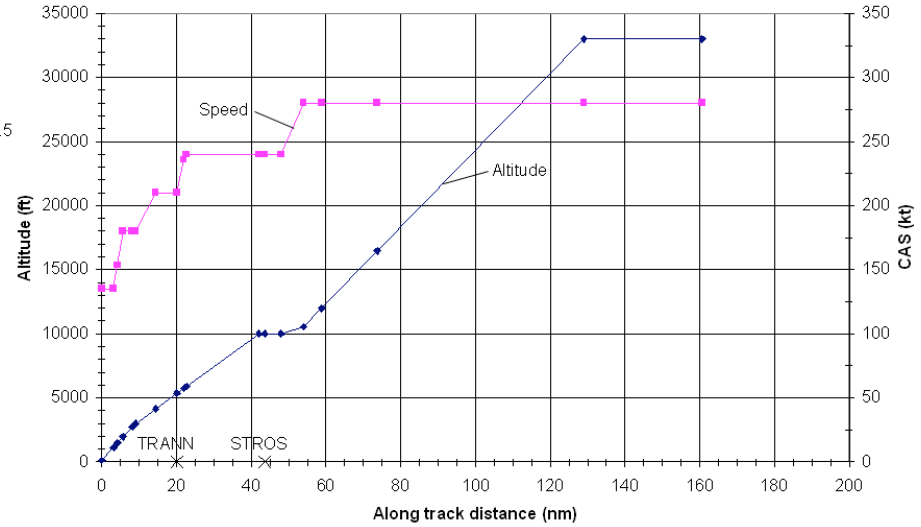
Profiles for CDA Descent to RW27

Path options



Vertical and speed profiles along nominal path



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Estimated Benefits for CDA Arrival to RW26L via DAS

- Both CDA and step-down arrival follow the same nominal ground track
- Both CDA and step-down have the same idle thrust descent profile from 33,000 ft to 11,000 ft
- Below 11,000 ft:
  - CDA descends along a 2° path with GS intercepted at 6,800 ft
  - Step-down has level flight segments at 5,000, 3,000 and 2,000 ft
- For a B737-700W A/C descending from 33,000 ft, BCOP estimates that CDA profile reduces:
  - Fuel burn by ~17 lb, or ~2.1%
  - Flight time by ~24 sec

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Summary

- Transition to final approach with a low engine thrust 2° FPA and different GS intercept altitude provide required vertical separation for independent parallel runway operations
- Path options in both Center and Tracon airspace support medium to heavy traffic conditions
- Pre-defined 3 D paths supports operations via voice for near-term implementation
- Basic flyability of this CDA profile has been checked out with Boeing FMS Test Bench
- Similar CDA profiles for independent RW 8L & 8R operations have been developed
- Detail CDA procedure and Center/Tracon handoff need to be completed

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